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Fuzzy-Proportional Integral Controller for an AGC in a Single Area Power System

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ABSTRACT

In the present work, the intelligent load frequency controllers have been developed to regulate the power output and system frequency by controlling the speed of the generator with the help of fuel rack position control. This paper presents the implementation of Fuzzy-Proportional Integral controller (FPIC) for controlling AGC in a single area power system. The aim of the proposed controller is to restore the frequency in a very smooth way to its nominal value in the shortest possible time whenever there is any change in the load demand etc. The action of this controller provides a satisfactory balance between frequency overshoot and transient oscillations with zero steady-state error. It is found that the proposed controller exhibits satisfactorily well dynamic performance and overcome all possible drawbacks associated with conventional PI controller.

Keywords: Automatic generation control (AGC), conventional proportional integral (PI) controller, Fuzzy-PI controller (FPIC), Fuzzy logic controller (FLC).

I. INTRODUCTION

Power system stability issue has been studied widely. The dynamic behavior of many industrial plants is heavily influenced by disturbances and, in particular, by changes in operating point. Load Frequency Control (LFC), or automatic generation control, is a very important issue in power system operation and control for supplying sufficient and reliable electric power [1]. Many investigations in the area of automatic generation control (AGC) of isolated and of interconnected power systems have been reported in the past and a number of control strategies have been proposed to achieve improved performance [2]. In the electric power generation, system disturbances caused by load fluctuation, result in changes in the desired frequency value. The conventional control strategy for the LFC problem is to take the integral of control error as the control signal [3].The proportional integral (PI) control approach is successful in achieving zero steady-state error in the frequency of the system, but it exhibits relatively poor dynamic performance as evidenced by large overshoot and transient frequency oscillations [2, 3]. Moreover, the transient settling time is relatively large. In the application of optimal control techniques, the controller design is normally based on a fixed parameter model of the system derived by a linearization process. Power system parameters are a function of the operating point. Therefore, as the operating conditions change, system performance with controllers designed for a specific operating point most likely will not be satisfactory [4]. Consequently, the nonlinear nature of the load frequency control (LFC) problem makes it difficult to ensure stability for all operating points when an integral or a PI controller is used.

More recently, fast acting artificial neural networks (ANN) have been developed. But the ANN approach has many inherent drawbacks like requiring of large historical database for proper training, network topology dependence and choice of proper response functions etc due to which exactly similar performance may not be obtained [2]. In order to improve the transient response, an intelligent controller for the LFC problem is developed and applied in connection with the power system under study. A Fuzzy-Proportional-integral controller (FPIC) is designed and implemented to improve the transient behavior of the system. A typical single-area power system is considered as a test network and simulation results are presented and discussed.

II. MODEL OF AGC IN A SINGLE-AREA POWER SYSTEM

In a single power system, load frequency control (LFC) equipment is installed for each generator. The controllers are set for a particular operating